IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA,	)	
	)	
Plaintiff,	)	
	)	
v.	)	**Case No. 05-cv-329-GKF(PJC)**
	)	
TYSON FOODS, INC., et al.,	)	
	)	
Defendants.	)	

DECLARATION OF ROGER L. OLSEN, Ph.D.

I, Roger L. Olsen, Ph.D., hereby declare as follows:

1. Since February 1985, I have been an employee of Camp Dresser & McKee Inc. ("CDM"), an environmental consulting firm. I currently hold the position of Senior Vice President and Senior Geochemist with CDM. My educational background includes a Bachelor of Science degree, with high distinction in Mineral Engineering Chemistry, from the Colorado School of Mines in Golden, Colorado, in 1972 and a Doctor of Philosophy degree in Geochemistry from the Colorado School of Mines in 1979.

2. From 1975 to 1978, I was an instructor in chemistry and geochemistry at the Colorado School of Mines. I taught courses in general chemistry and quantitative analysis. From 1978 to 1979, I was a senior research chemist with Rockwell International at the Rocky Flats plant. I was responsible for evaluating methods to clean up contaminated soil at Rocky Flats and other Department of Defense facilities. From 1979 to 1983, I was a project supervisor with D'Appolonia Consulting Engineers. In 1983, International Technology (IT) acquired the portion of D'Appolonia for which I worked. At D'Appolonia and IT, I performed many evaluations related to environmental contamination. In 1985, I joined CDM where I continued to evaluate environmental contamination. I have extensive experience in performing environmental

investigations and studies, evaluating the environmental fate and transport of chemicals in the environment and determining the cause or source of contamination in the environment. In all, I have worked on or evaluated environmental conditions at over 500 sites. I am the author or co-author of over 120 publications/presentations and over 400 technical reports relating to environmental contamination. My education includes graduate level courses in statistics. For over 30 years, I have routinely performed statistical analyses as part of my evaluation of environmental data. I have taught statistical courses in conjunction with Dr. Chappell to State Regulatory Agencies and CDM staff (CDM University). I have performed principal component analyses (PCA) many times to assist in understanding the relation of multiple parameters and to identify sources of contamination. As part of a weight of evidence approach, I performed multivariate analyses for the Department of Justice to evaluate the sources of groundwater contamination at the Sharon Steel Superfund site. This work was performed as part of the litigation efforts at the Sharon Steel site and was not challenged. The results of these analyses were subsequently published (R.L. Olsen and D.D. Wilson, 1993, Source Identification and Allocation of Soil and Groundwater Contamination Near a Milling Superfund Site. Proceedings of the Superfund XIV Conference. November 30-December 2, 1993).

3. In November 2004, CDM was retained by the Oklahoma Attorney General to perform an investigation concerning environmental contamination found in the Illinois River Watershed ("IRW"). I have been CDM's Project Technical Director since inception of the project. In this capacity, I have helped plan and direct a systematic investigation of the environmental contamination found in the IRW. This investigation included collection and laboratory analyses of poultry waste, soils, surface waters, groundwaters and sediments throughout the IRW.

4. I have reviewed Defendants' Motion To Exclude Dr. Roger Olsen's Principal Component Analysis Testimony Pursuant to Daubert v. Merrell Pharmaceuticals, Inc and Integrated Brief In Support submitted May 18, 2009 ("Defendants' Motion"). I have reviewed the opinions of Dr. Charles Cowan provided in his rebuttal report ("Rebuttal Report, Review of Principal Components Analysis of Data and Review of Inferences about Presence of Biomarkers in the Population of Animals from the Illinois River Watershed, November 26, 2008") and in his deposition transcript ("Deposition of Charles Cowan, PhD, February 17-18, 2009"). I have reviewed the opinions of Dr. Brian Murphy provided in his rebuttal report ("Expert Report of Brian Murphy, PhD, January 23, 2009") and in his deposition transcript ("Deposition of Brian Murphy, PhD, March 25-26, 2009"). And I have reviewed the opinions of Dr. Glenn Johnson provided in his rebuttal report ("Rebuttal Report, Principal Components Analysis of Geochemical Data from the Illinois River Watershed, Northwest Arkansas and Eastern Oklahoma, November 21, 2008") and in his deposition transcript ("Deposition of Glenn Johnson, PhD, February 24-25, 2009").

5. As discussed in the above paragraphs, one of my roles was to assist David Page in his efforts to coordinate the State's technical experts. As part of this role, I helped coordinate and facilitate meetings of the technical experts. Mr. Page's September 14, 2005 FAX to me ("OPL- Strategy/Guidelines for Preliminary Injunctive Relief", Motion Exhibit 10) was Mr. Page's summary of a meeting of technical experts for my review. At this meeting the various experts summarized their current understanding of the information collected to date and their recommendations for evaluations and studies. At this meeting (and previous meetings) I had discussed the use of multiple lines to evidence to evaluate the sources of contamination in the IRW. One of the methods I had previously used (including work for the US Department of

Justice) was principal component analysis (PCA). I recommended that principal component analysis be evaluated as a potential line of evidence to evaluate sources in the IRW. Other evaluations discussed in the FAX did not prove to be as definitive and were not completed. The statement of pg 8 of the Motion that Plaintiffs counsel "instructed" me to use PCA is false. As discussed above, I had used PCA before in conjunction with other lines of evidence and the use of PCA was my proposal as one of the methods to evaluate sources of contamination in the IRW.

6. From the beginning of my involvement in the IRW evaluations for the State, I consistently and regularly stated that the approach I recommended for the evaluation of sources and causation in the IRW was a weight of evidence approach that evaluated multiple lines of evidence. Initial lines of evidence evaluated by me included pathway sampling, Tenkiller core analysis, concentration trends, correlation of phosphorus concentrations and poultry house density, indicator chemicals (spatial and gradient evaluations) and principal component analysis. Based on my past experience in identifying sources of environmental contamination, I had determined that rarely a "sliver bullet" (i.e., one definitive line of evidence) exists. Rather, a weight of evidence approach using multiple lines of evidence is the most productive and definitive evaluation method to use. Dr. Murphy used multiple lines of evidence in his past work (Murphy deposition pp. 8 and 9) and Dr. Johnson testified that use of multiple lines of evidence was an appropriate and common approach for source evaluation (Johnson deposition p. 25).

7. My expert report provides the multiple lines of evidence I used to support my opinions that land applied poultry waste and waste water treatment plant (WWTP) discharges are the dominant sources of contamination in the IRW waters. Specifically Section 6 of my report discusses each of these lines of evidence including: IRW geology and hydrogeology (developed by Dr. Fisher); chemical and bacteria composition of various contaminant sources in the IRW;

mass balances of phosphorus, bacteria and other contaminants (developed by Dr. Engel and Dr. Teaf for phosphorus and bacteria; I independently developed leaching mass balances for bacteria, phosphorus and other contaminants); overall pathway sampling approach and chemical/bacterial contaminants observed in each environmental component (concentrations gradients); nature and extent of contamination throughout the IRW (spatial analysis); fate of poultry related contaminants (developed by Dr. Fisher); small basin phosphorus concentrations relationships to poultry house density (developed in conjunction with Dr. Engel); modeling of runoff and surface water (by Dr. Engel); evaluation of the poultry house biomarker (developed by Dr. Harwood); and the chemical and bacterial signature of contamination sources use principal component analysis (PCA). As shown, principal component analysis was only one of many lines of evidence evaluated to arrive at my opinions concerning the sources of contamination in the IRW. All of these methods are traditional techniques that constitute the evidence that environmental scientists use to identify the cause(s) of contamination and, accordingly, are used to describe the "fate and transport" of contaminants.

8. As discussed in my expert report, all of these lines of evidence support by opinions concerning the sources of contamination in the IRW. See page 6-66 to 6-67 of Olsen Expert report (Defendants' motion Exhibit 2): "The multiple lines of evidence all support that poultry waste disposal by land application is a major source of contamination including phosphorus and bacteria in the IRW. These lines of evidence include the chemical and bacterial composition of major waste sources compared to contamination in the IRW, mass balance calculations showing that poultry waste is a major source of contamination, fate and transport observations for poultry waste contaminants throughout the IRW, analyses and detection of a

poultry specific biomarker and PCA evaluations showing poultry waste contamination is a dominant source."

9. Principal component analysis (PCA) is a well accepted scientific theory and methodology to evaluate sources of contamination. Both Dr. Johnson and Dr. Murphy have used multivariate techniques including PCA to evaluate sources of contamination in the environment (Murphy deposition pp 50 and 51; Johnson deposition pp 12, 16, 27, 34, 35, 37, 38, 45). I have reviewed over 60 abstracts of published papers that have used multivariate statistical methods (including PCA) to evaluate environmental data. I have reviewed in detail over 25 of these published papers that are most applicable to the IRW because of their similar conditions (i.e., basin wide watershed water quality studies typically with nonpoint source pollution that include contaminants that are also naturally occurring constituents). All of these papers have identified sources of contamination based on multivariate techniques (such as PCA) including both nonpoint sources and agricultural sources. The published papers identifying nonpoint sources and agricultural sources include:

- F. Zhou, et al, 2007, Spatial distribution of heavy metals in Hong Kong's marine sediments and their human impacts: a GIS-based chemometric approach, marine Pollution Bulletin 54, 1372-1384 ("PCA further identified three potential sources, two of which were due to human impacts..,"; the main human impacts included "agricultural runoff")
- V. Simeonov, et al, 2003, Assessment of the surface water quality in Northern Greece, Water Research 37, 4119-4124 (the second PC is the "nutrient factor" and "represents influences from non-point sources such as agricultural runoff...")
- P. Kannel, et al, 2007, Chemometric application in classification and assessment of monitoring locations of a urban river system, Analytica Chimica Acta 582, 390-399 ("Factor

1....describes the chemical factor of pollution."; "...the sources of NO_3N, NO_2N, Ca, Mg are anthropogenic as well as runoff from agricultural fields.")

- G. Mihailov, et al, 2005, Multivariate statistical assessment of the pollution sources along the stream of Kamchia River, Bulgaria, Water Science & Technology, vol 51, no. 11, pp 37-43 (a "farming factor" was identified as a pollution source)

- Q. Zhang, et al, 2009, Assessment of surface water quality using multivariate statistical techniques in red soil hilly regions: a case study of Xiangjiang watershed, China, Environ. Monit. Assess., 152:123-131 (principal component 2 or "PC2 represents pollution from domestic wastewater"; "PC3 represents point and non-point source pollution from orchard and agriculture areas.")

- T. Kazi, et al, 2009, Assessment of water quality of polluted lake using multivariate statistical techniques: A case study, Ecotoxicology and Environmental Safety, 72, 301-309 (PCA "helped in identifying the factors or sources responsible for water quality ..... the main cause of degradation of the lake is discharge of industrial, agricultural wastes and of municipal sewage water....")

- C. Iscen, et al, 2009, Evaluation of surface water quality characteristics by using multivariate statistical techniques: A case study of the Euphrates river basin, Turkey, Envrion. Monit. Asess., 151:259-264 (two factors explaining the variance in water quality were identified; "F1 is called as "urban land use" factor"; "F2 is called as "agricultural use" factor")

- K. Bengraine and T. Marhaba, 2003, Using principal component analysis to monitor spatial and temporal changes in water quality, Journal of Hazardous Material, B100, 179-195 ("These extracted patterns were of natural, urban, industrial and agricultural origins.")

- B. Helena, et al, 2000, Temporal Evolution of Groundwater Composition in an Alluvial Aquifer (Pisuerga River, Spain) by Principal Component Analysis, Wat. Res., Vol 34, No. 3, pp 807-816 ("other PCs are contributed by nitrate and trace elements…..nitrate may originate from fertilizers (both agricultural and industrial), and trace metals from leachates of industrial wastes and/or manure piles."

- C. Mendiguchia, et al, 2004, Using chemometric tools to assess anthropogenic effects in river water A case study: Guadalquivir River (Spain), Analytica Chimica Acta, 515, pp 143-149 ("PC2 (22.5% of the variance) is mainly contributed by the variables affected by agriculture activities (PO_4^{3-} and SS)….")

All of these published papers used multivariate statistical techniques (usually PCA) to evaluate environmental water quality and sediment data and to identify sources of contamination; in particular, nonpoint and agricultural contamination. As shown by these peer reviewed papers, the principle and theory of applying PCA to evaluate water quality data including identification of sources of contamination is well accepted. In addition these papers document that PCA is a well accepted theory and method for evaluating nonpoint agricultural contamination such as I did in my IRW study. Therefore, PCA is an accepted method to evaluate the IRW water quality and sediment data in order to identify significant sources of contamination (i.e., land applied agricultural manures (including poultry waste) and WWTP discharges).

10. In addition to being a well established scientific method to evaluate sources, the procedures I used to perform the PCA were reliably applied and their application is consistent with many published papers. The following published papers used techniques similar to those I used:

- V. Simeonov, et al, 2003, Assessment of the surface water quality in Northern Greece, Water Research 37, 4119-4124 ("elements..... which exhibited values usually lower than the detection limit of the method were excluded"; dataset was scaled "by z-transformation")

- P. Kannel, et al, ("Box-Cox transformation was used to transform the data set in normal form"; "The data were standardized (to the Z score with mean = 0 and S.D.=1)..."). [Note: Box-Cox transformation is a natural log transformation.]

- C. Buler, et al, 2002, Evaluation of graphical and multivariate statistical methods for classification of water chemistry data, Hydrogeology Journal, 10:455-474 ("The data were long-transformed....so that they more closely corresponded to normally distributed data. Then, all 11 variables were standardized by calculating their standard scores (z-scores)...")

- K.Singh, et al, 2005a, Estimation of Source of Heavy metal Contamination in Sediments of Gomti River (India) using Principal Component Analysis, Water, Air and Soil Pollution, 166: 321-341 (data set was "standardized through centered log ratio followed by z-scale transformations")

- K. Singh, et al, 2005b, Chemometric Analysis of Hydro-Chemical Data of and Alluvial River – A Case Study, Water, Air, and soil Pollution, 170:383-404 (PCA "....applied on experimental data standardized through z-scale transformations...")

- B. Helena, et al, 2000, Temporal Evolution of Groundwater Composition in an Alluvial Aquifer (Pisuerga River, Spain) by Principal Component Analysis, Wat. Res., Vol 34, No. 3, pp 807-816 ("...all variables are automatically autoscaled to mean zero and variance unit."). [Note: autoscale is the same a z-transformation.]

- Q. Zhang, et al, 2009, Assessment of surface water quality using multivariate statistical techniques in red soil hilly regions: a case study of Xiangjiang watershed, China,

Environ. Monit. Assess., 152:123-131 ("Principal component analysis/factor analysis was performed on the normalized data sets...."

- T. Kazi, et al, 2009, Assessment of water quality of polluted lake using multivariate statistical: A case study, Ecotoxicology and Environmental Safety, 72, 301-309 ("....standardization (z-scale) was made on each chemical prior to the statistical analysis..."; "calculation was performed based on the correlation matrix of chemical components and the PCA scores were obtained from the standardized analytical data.").

In particular, the above published references demonstrate that the data used for PCA can be treated in a variety of methods. Almost all of the published studies used a z-scale transformation to standardize the data. Several researchers also log-transformed the data to obtain normal distributions. I did both of these transformations. None of the published articles cited above used ratios, fractions or percentages before PCA evaluations. I did not use ratios, fraction or percentages. Dr. Johnson and Dr. Murphy stated that I should have performed such data treatment ("sample normalization" so all data are ratios or fractions) (for example see p A-18, second paragraph of Johnson's report, Exhibit 7 of Defendants' motion). However, both Dr. Johnson and Murphy have used PCA to evaluate synthetic chemicals such as PCBs where this data treatment may be appropriate. As shown, such treatment of the data is not used for basin wide studies concerning nutrients and naturally occurring contaminants such as nutrients. If ratios or fractions are used, all information concerning concentrations is lost and not contained in the PC scores.

Most of the published papers cited in paragraphs 9 and 10 use spatial analyses and chemical composition of known wastes to evaluate the results of their multivariate analyses and identification of sources. Kazi et al (2009) evaluated the PCA results at specific sites and also

performed gradient evaluations; Zhou et al (2007) did a very thorough evaluation of the spatial distribution of factor scores; Kannel et al (2007) and Singh et al (2005a) evaluated factor scores or PC scores at various study locations; Mihailov et al (2005) evaluated the chemical composition and principal components at sites in the study; Mendiguchia et al (2004) identified zones of different quality based on the PCA. All of these are spatial analyses; i.e., evaluating the PCA results at particular locations or with particular types of samples. This is the same type of spatial analyses and gradient evaluations that I performed. Iscen et al (2009), Zhang et al (2009), Simeonov et al (2003), Zhou et al (2007) and Kannel et al (2007), to name a few of the papers, associate specific chemicals in the principal components with the chemical compositions of known wastes. Many of the researchers associate principal components or loadings with particular sources (Simeonov et al (2003), Zhou et al (2007), Zhang et al (2009) and Singh et al (2005b) to name a few of the researchers. This is the same type of evaluations of chemical composition of wastes I did to identify sources.

11. The data used to perform the PCA was collected using a "systematic planning process" to maximize the probability that the data were representative, reliable and usable for all intended purposes. Data collection was consistent with EPA guidance (EPA Quality Manual for Environmental Programs, EPA Order 5360 A1; Guidance for the Data Quality Objective Process, EPA QA/G-4). Only selected samples were analyzed for a complete list of parameters (chemical/bacterial constituents). These were the samples to be used in the PCA. Other samples were analyzed for a more limited list of parameters and had other intended uses. The samples for use in the PCA were selected using a well designed and systematic plan to assure that the samples were representative and reliable. In some cases, this selection included all samples collected at particular locations (e.g., samples collected on larger streams by USGS for this

study). Many samples were also collected using a stratified random design to assure representative samples of the whole basin were collected. For each program the sampling objectives, intended data use, types of data to be collected, sampling approach and scheme (sampling design), sampling times and field and laboratory analyses are documented in Section 2 of my expert report. The statements in the Motion (pp 19-20) that the ACCESS database was "mined for data" and that the samples were "hand-selected" is simply not true. As discussed above, the samples to be used in the PCA were predetermined using systematic designs that assured samples were representative and that samples from all environmental components in the pathway from sources to ultimate deposition were collected and analyzed.

12. The Defendants' statement on page 20 of their motion that "some samples have no data for some constituents because the tests were run came back as "non-detects"…" is not correct. Constituents with reported concentrations below the analytical detection limit were entered into the database at ½ the value of the detection limit. This value was used in the PCA. This approach is the most commonly used practice by environmental scientists and the same method used by Defendants' expert Dr. Johnson (1998, Identification of historical PCDD/F sources in Newark Bay Estuary subsurface sediments using polytopic vector analysis and radioisotope dating techniques, Chemosphere, Vol 36, pp 1167-1185). In conducting his own PCA, Defendants' expert Dr. Murphy also used this method.

13. The Defendants' motion (p. 20) discusses the fact that some samples were analyzed more than once. Averaging was performed on samples that were split into two or more samples from one larger sample that had been completely mixed in one large container. This type of sample is called a duplicate or split sample and is a standard part of quality control to

access laboratory precision. The results of these samples were averaged consistent with the methods used my most environmental scientist and also used by Dr. Murphy.

14. The methods I applied in treating the data and conducting the PCA were well documented in my Expert Report and considered materials. In particular all protocol and queries are documented in detail in the main database (IllinoisMaster.mbd) and separate EXCEL workbooks (PCA_Main_Database_Water.xls and PCA_Main_Database_Solid.xls). Any scientist familiar with environmental data and statistical analysis would be able to repeat and test my methods. Indeed, both Dr. Murphy and Dr. Johnson (for example see Johnson's May Declaration, Defendants' motion Exhibit 12) were able to reproduce my PCA evaluations and arrive at the same results. Dr. Cowan could not reproduce my evaluations because of his lack of understanding of environmental science and incomplete review of my documentation (e.g., queries in ACCESS).

15. I conducted sensitivity analyses to evaluate if the PCA results would change due to changes in data selection, data treatment, and/or PCA methods. Various investigative analyses were conducted to evaluate the sources in various environmental components (e.g., groundwater and springs). The evaluation of changes in data treatment/selection and evaluation of sources were performed by evaluating the results including the patterns in the PC score plots from different PCA runs. The various PCA runs are discussed in Step 14 of my expert report (Exhibit 2, Defendants' motion, pp 6-62 – 6-66) and are summarized in Tables 6.11-7a and 7b (Exhibit 2, Defendants' motion). My report clearly states the purposes of each of these runs. The results clearly show that the Defendants' experts have no basis to criticize my treatment of data including use of samples with some missing data, use of dissolved and total metals, use of multiple phosphorus forms and use of multiple bacteria. These PCA runs are necessary in order

to test the affects of data treatment and to determine sources of contamination if all media. Sensitivity runs are a required part of the evaluation and testing process for many scientific studies. For example, scientists that perform environmental modeling perform sensitivity runs where they change the input parameters to determine the effects on the results. In modeling, these sensitivity runs would be used to determine the validity and robustness of the model and magnitude of change (similar to an error rate). The Defendants' motion (p 21) states that the "substantial amount of missing data results in several biases". As discussed above, sensitivity analyses were performed using only samples with no missing data. The results of these PCA runs were then compared to the results of PCA runs using samples with some missing data. The results indicate that the missing data does not result in biases.

16. Likewise investigative runs were performed to help in interpretation of the results. For example, the importance of high flow and base flow samples, the difference between dissolved vs. total concentrations, and sources of groundwater and spring contamination were evaluated using different PCA runs. These multiple runs were not "arbitrarily and selectively chosen for presentation" as stated in the Defendants' motion (p 9). As explained above, they were part of my testing of data selection and treatment and evaluation of different sources. Any good scientist would do the same. These runs helped to confirm my opinions concerning the dominant sources of contamination in the IRW. In contrast to the statement in Defendants' motion (p 10), the need and purpose of these multiple runs were carefully explained in my expert report.

17. As previously discussed, I used a weight of evidence approach to form conclusions. Many of these lines of evidence consisted of methods which are considered fate and transport analysis. First of all, I considered the mass balances and the amount of poultry

waste generated in the IRW. I also evaluated the other sources and masses of contaminants (bacteria and phosphorus). This is the first step in any traditional fate and transport analysis (amount of waste). I then evaluated the amounts of poultry waste applied to fields, the locations of application and the methods of waste disposal (field application or disposal). I also evaluated the amounts of WWTP discharge (phosphorus and metals) and the locations. This is the second step in a traditional fate and transport analysis (how and where the waste was disposed). I then evaluated the chemical and bacterial composition of all major sources of contamination in the IRW based on the above studies and other published studies (poultry waste, cattle manure and WWTP discharges). This is also an evaluation step in a traditional fate and transport analysis (determination of the composition of the wastes). Next I evaluated the nature (chemical and bacterial composition) of the leachate generated from the poultry waste. I did this evaluation by collecting actual samples of runoff from fields on which poultry waste had been applied. I also performed synthetic precipitation leaching tests on poultry waste and cow manure. I then performed calculations of the relative masses of many contaminants that would leach from the poultry waste and cow manure. The collection of runoff samples and performance of leaching tests in the next step in a traditional fate and transport analysis (determining what contaminates actually enter the surface water and groundwater using leaching tests or empirical samples, i.e., field runoff). I then collected samples of the other various environmental components (rivers and streams, Lake Tenkiller, soil, sediments, etc.) of the IRW to determine levels of contamination by comparing the chemical/bacterial composition of these samples to samples collected from unimpacted environmental components (background or reference samples). I designed the collection of samples in a pathway approach so samples were collected in each major environmental component downgradient of waste disposal locations. For waters, samples

were collected from the runoff of poultry waste applied fields, then small stream basins, then larger streams/rivers and then Lake Tenkiller). Thus, the transport of chemicals and bacteria was followed from the source to the ultimate fate location. As noted above, I also sampled reference locations to compare the levels of chemical and bacterial found in the IRW. This enable me to conduct a detailed gradient evaluation of major contaminates in the IRW and compare concentration levels to background levels. The collection of samples and gradient evaluation are the next steps in a fate and transport analysis (documentation of the levels of contaminants in the environment and an evaluation of the concentrations changes from source disposal location to deposition location). I then compared the levels and types of contaminants in the wastes (sources) to those in the environmental samples (samples of surface water, sediments, etc) that were collected from the IRW. This is also a traditional step of a fate and transport analysis. This was done directly by evaluating the spatial distribution of individual contaminants (e.g., phosphorus and bacteria) throughout the IRW (surface water, sediments, soils, etc) to see how the contaminants were distributed throughout the IRW. This is also a step often used in fate and transport analyses. In addition to these fundamental steps of any traditional analysis, additional more sophisticated fate and transport analysis were performed by me and other State experts. These included modeling of phosphorus (field runoff/infiltration and stream routing modeling by Dr. Engel; Tenkiller modeling by Dr. Wells); evaluation of phosphorus levels in relationship to poultry house density in small basins (Dr. Engel); geochemical evaluations of sediments in streams and Lake Tenkiller (Dr. Fisher); geochemical (thermodynamic) modeling by me to evaluate and explain chemical changes and geochemical reactions that occur between poultry waste leachate and soils; hydrological and geological pathway analysis (Dr. Fisher); and Lake Tenkiller sediment chemical and age dating analysis

(Dr. Fisher). All of these evaluations are transport and fate analysis that would be used by environmental scientists in evaluating contaminant transport and fate in the IRW. From my analyses discussed above, my knowledge of the fate and transport of chemicals and my understanding of the types and sediments and chemicals species in the IRW waters, I have concluded that the fate and transport analyses conducted in the IRW were appropriate and sufficient; no additional more complex analyses such as determining partitioning between chemical species and sediments in the IRW rivers were necessary.

18. Page 4, footnote 1: The "September 30 errata" was authored by me on September 24, 2008. As stated in the errata, the corrections and contents of the errata were provided to the Defendants during my September 10-11, 2008 deposition. The September 30 errata were not "submitted to bolster Dr. Olsen's opinions in light of observations made by defense experts in their reports and questions posed by defense counsel in his deposition..." At the time of deposition and providing the correction to the Defendants, Defendants' expert reports had not been submitted and questions had not be posed by defense counsel concerning the corrections.

19. My PCA evaluations were independently peer reviewed by Dr. Jim Loftis, Colorado State University Professor. Dr. Loftis was able to independently repeat my PCA using different statistical software than I used. Dr. Loftis concluded that my application of PCA was appropriate including using log-transformation and using concentrations in the computation of PC scores. Dr. Loftis also agreed with my interpretation of the PCA results: that PC1 is associated with poultry waste application, PC2 is associated with municipal wastewater discharges and the PC1 scores are spatially distributed in a pattern that is consistent with increasing poultry waste impact in water bodies that are closest to areas of poultry waste application and decreasing impact as one moves downstream.

20. My opinions are corroborated by other researchers and published papers that show the waters are very contaminated, that the major source of this contaminant load is nonpoint runoff and that fields with animal manure are a substantial source of the phosphorus. The USGS (R. Tortorelli and B. Pickup, 2006, Phosphorus Concentrations, Loads and Yields in the Illinois River Basin, Arkansas and Oklahoma, 2000-2004) stated that the "Estimated mean flow-weighted concentrations were more than 10 times greater than the median (0.022 milligram per liter) and were consistently greater than the 75th percentile of flow-weighted phosphorus concentrations in samples collected at relatively undeveloped basins of the United States (0.037 milligram per liter)." That is, the waters in the IRW are highly contaminated with phosphorus. My analyses of the water collected in the IRW confirm this conclusion. Over half of the surface water samples collected contained phosphorus concentrations in excess of the Oklahoma standard of 0.037 mg/L. In their published paper, the USGS researchers also state that "...from about 83 to 90 percent of the annual phosphorus load was transported to Lake Tenkiller by runoff." That is, the majority of the phosphorus load is from nonpoint sources. These conclusions have also been stated by other researchers including M. Nelson, et al., 2002, Illinois River Phosphorus Sampling Results and Mass Balance Computation, Arkansas Water Resources Center, MSC-336 ("57 % of the phosphorus in the river output originated from the non-point sources"). Many researchers have also identified that poultry waste application results in runoff from applied fields with substantial increases in phosphorus, nitrogen, potassium, aluminum, copper, iron, arsenic, and zinc in the runoff water (T. J. Sauer, et al, 1999, Poultry Litter and Grazing Animal Waste Effects on Runoff Water Quality, J. Environ. Qual. 28:860-865; P.A. Moore, Jr., et al, 1998, Decreasing metal Runoff from Poultry litter with Aluminum Sulfate, J. Environ. Qual., 27:92-99). The findings of these researchers are consistent with my observations

of large concentrations of these same chemical parameters in runoff from fields with documented poultry waste application. I also observed large concentrations of bacteria in the actual runoff samples.

21. Like many other researchers, I used spatial analyses as one tool to assist in my interpretation of the PCA results. In particular the locations and type of samples were evaluated in relation to their grouping on plots of PC1 vs. PC2 scores. By type of sample, I mean type of environmental component sampled: runoff, small tributary, large stream, Lake Tenkiller, reference, etc. The patterns in the PC score plots were very definitive: field runoff (edge of field) samples, WWTP samples and reference samples typically plotted separately. The remaining samples tended to merge into the WWTP and edge of field samples indicating a mixture of reference (uncontaminated) water with contamination from runoff of fields with poultry applied waste and with contamination from WWTP discharges. All three of Defendants' experts (Dr. Cowan, Dr. Johnson and Dr. Murphy) concluded that these three types of samples plotted in separate groups with no overlap on the PC1 vs. PC2 score plots (Johnson deposition page 194 and exhibit 7; Murphy deposition page 409 and exhibit 32; Cowan deposition page 242 and exhibit 19). In all my PCA water runs, I was able to identify these three groups. I carefully examined the PC1 and PC2 scores of all samples in these three groups. In addition, I carefully evaluated the PC1 and PC2 scores of hundreds of other samples to determine the groups of samples dominated by poultry waste and those dominated by WWTP discharges. I also examined the chemical/bacterial composition of many of these samples to verify that the concentrations of the parameters were consistent with their locations in the IRW and their grouping (e.g., uncontaminated, contaminated by poultry waste and contaminated by WWTP discharges). An example of this extensive evaluation is provided at the bottom of page 6-58 of

my expert report where I discuss the 65 highest PC2 scores (Exhibit 2 to Defendants' motion). As stated, of the 52 surface water samples in this group, 48 were downgradient of WWTP discharge. To make this determination I actually located over 100 samples with the highest PC2 scores on a map of the IRW and determined their locations relative to WWTP discharges. This is a spatial analysis. I also evaluated the chemical/bacterial composition of most of these samples to confirm that they were impacted by WWTP discharges. The results of this evaluation are also documented in my considered materials (Table 6.11-11, Largest PC2 Scores and Locations). Likewise, the locations of samples with the highest PC1 scores were also evaluated (see bottom of page 6-57 of my expert report, "Of the top 50 samples with highest PC1 scores....44 are edge of field samples."; Exhibit 2 to Defendants' motion). The locations and chemical/bacterial composition of the lowest PC1 and PC2 scores were also evaluated. This was an extremely important evaluation that documented that samples from reference locations and locations with low poultry house density had the lowest PC1 scores (see discussion on top of page 6-58, Exhibit 2 to Defendants' motion). As shown in this paragraph, the statement in the Defendants' motion (p 12) that I only examined a "handful of samples, for example only 27 of the 572 samples" for my spatial analysis is simply not true.

22. Concerning my spatial analyses, the Defendants' motion (p 12) states that my "handpicked examples ignored the many samples that contradict" my conclusions. Dr. Johnson attempted to test my results by plotting locations on a poultry house density map. The map used by Dr. Johnson was an out of date, a preliminary map used only to initially select the locations of groundwater samples. However, as illustrated by exhibits in Johnson's deposition (Johnson Deposition, exhibits 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22), Dr. Johnson ignored locations of land applications of poultry waste, the actual documented locations of poultry houses, and the

determination of the actual watershed upgradient of the sampling points. If Dr. Johnson would have performed his tests using the correct information, he would have confirmed my conclusions.

23. The defendants' motion (pp 12 and 13) discusses the five samples taken near Tahlequah. To be conservative and error in favor of the defendants', I originally classified these samples as nonimpacted by poultry waste. In my deposition, I admitted that this was wrong. Subsequently and consistent with my deposition testimony and the principle that any good scientist continues to seek explanations of apparently anomalous data, additional studies by Dr. Fisher have been conducted in the area upgradient of the five sampling locations. These investigations have documented land application of poultry waste upgradient of the five sampling locations. (see Exhibit 21 of Johnson's deposition). Therefore, the spatial analysis using the locations of land application is consistent with the PCA classification of these samples (poultry impacted). I have corrected my original error (see my Declaration of February 2009; Exhibit 8 to Defendants' motion).

24. The Defendants' motion (pp 13 and 14) also discusses samples that were collected from ponded areas (bermed areas) on a field where cattle were present (EOF-CP-1A and EOF-CP-1B). Consistent with my deposition testimony and the principle that any good scientist continues to seek explanations of apparently anomalous data, additional studies have been performed concerning these samples (see Johnson deposition Exhibit 22). In particular, these samples are not edge of field samples, but came from ponded areas on the field where the water could react with the underlying soil. In addition, the field and soil were very different than other fields in the IRW. Most important, an upgradient spring (sample SPR-FITE-01) that drains unto the property where the samples were collected and a groundwater well (GW-FITE-01) in the

vicinity of the field were contaminated with poultry waste constituents (e.g., phosphorus, bacteria, zinc, etc). Contamination from the spring certainly was transported onto the field and accumulated in the soils behind the berms where the samples were collected. In addition, poultry waste has been land applied in the area and poultry waste is routinely transport on the road adjacent to the field. All of these observations contribute to the fact that these samples (EOF-CP-1A and EOF-CP-1B) were not representative of only cattle manure contamination and likely contained poultry waste related contamination consistent with the PC1 scores.

25. The Defendants' motion (p 13) discusses the "inaccuracies" of the WWTP samples. The effluents from Springdale, Rogers and Siloam Springs all contain poultry processing waste and may be contaminated by poultry related constituents. These three samples of the discharges were also collected after large rainfalls and the discharge flows from the WWTPs were two to four times normal values. This reflects the very large amount of inflow and infiltration (I/I) that entered the sewer lines from storm runoff. I/I typically contains contaminated runoff and contaminated groundwater. The Lincoln WWTP sample was not a discharge sample, but was collected in a river over 0.8 miles downgradient of the WWTP discharge point (see Johnson deposition exhibit 13). This sample collection location is downgradient of areas of poultry waste application and poultry houses.

26. I have not changed my opinion that the compositions of poultry waste and cattle manure are distinct (Defendants' motion p 14). This is confirmed by the actual chemical/bacterial compositions contained in my expert report and my PCA evaluations. Both Drs. Johnson and Murphy also agreed that the compositions were different (Johnson deposition pg 134 and Murphy deposition pages 189, 191, 192). I have continued to state that although cattle manure has a distinct composition, the cattle manure does not contribute a substantial

amount of contamination (has "no dominant impact") and therefore no distinct pattern exists on the PC score plots and cattle manure is not associated with a particular PC. The minor cattle contribution is confirmed by my mass balances using the synthetic precipitation leachates and Dr. Engels modeling. The words "distinct" and "dominate" are two different concepts. The Defendants' motion (pg 14) has apparently confused these two words.

27. Footnote 9 on page 14 of Defendants' motion is not correct. Different samples were never averaged. As previously discussed, only duplicate samples split from the same sample were averaged. Dr. Johnson is simply confused about the identification of these samples. The average he calculated does not appear on my figures.

28. Exhibit 10 of Defendants' motion (May Declaration of Dr. Johnson) is a new analysis recently performed by Dr. Johnson. In this declaration, Dr. Johnson states multiple times that the statement in my February 10, 2009 Declaration (Exhibit 8 to Defendants' motion) that the programming error "had no impact on the PCA results" is incorrect. This is simply not true. Consistent with statistical terminology and the clear definition in my February 10, 2009 Declaration, the actual results of the principal component analysis (PCA) which consisted of identifying principal components and determining principal loadings and coefficients were not affected by the programming error ("had no impact on the PCA results"). Simply stated, the principal components and values for the loading and coefficients did not change. The PC scores were determined separately from the PCA and as clearly identified in my Declaration, the PC scores were impacted by the programming error. However, the programming error had little effect on the spatial distribution of the PC scores.. As a result, my opinions and overall conclusions did not change. Drs. Johnson, Murphy and Cowan all concluded that the three groups (WWTP, runoff EOF and reference samples) were still separate on the corrected PC score

plot (Johnson deposition page 194 and exhibit 7; Murphy deposition page 409 and exhibit 32; Cowan deposition page 242 and exhibit 19). If anything, the correction of the PC scores more clearly identified the groups and confirmed my opinions. The Defendants' motion (pp 15 and 16) discusses the number of samples that changed classification as a result of the programming error. Even thought the error changed classification of samples, the total number of samples locations showing some poultry contamination only changed from 134 to 135 using the mean PC scores from PCA run SW3 (surface water). Therefore, the percent of poultry contaminated locations changed from 77.91 % to 78.49 %. The number of samples with some poultry contamination decreased from 437 to 429 (the percent of poultry contaminated samples decreased from 76.7 % to 75.3 %). Clearly the conclusions concerning the widespread poultry contamination are still accurate. The classification of groundwater samples changed slightly more but did not affect my overall opinions. I have performed the correction of the scores for all my PC runs and these are available if needed.

29. On pages 21 to 24 of Defendants' Motion, statements are made concerning "substitute and hypothetical data", "averaging multiple values for the same sample", "substitution of inconsistent values for non-detects", "merging incompatible datasets", and "unexplained data substitution and incomplete data sets". These statements have no basis in the actual facts. Contrary to Defendants' statements, I did not substitute the mean for missing data (Defendants' motion p 21). Substituting the mean is not mathematical equivalent to the method I used (pairwise deletion) (Defendants' motion pg 21, footnote 13). As previously discussed, contrary to Defendants' statement, I did determine the significance of missing values using sensitivity analysis (Defendants' motion p 22). As previously discussed, I treated results from split samples appropriately and in the same method as Defendants' experts (Defendants' motion

p 22). As previously discussed, use of ½ the detection limit did not create data and did not distort the analysis (Defendants' motion pp 22 and 23). Contrary to Defendants' statements, the USGS data and CDM data are compatible and can be used together (Defendants' motion p 23). I personally worked closely with USGS to make sure the analytical methods were the same as ours and the results could be used together. The methods used to select data for the PCA runs were well documented and could be repeated by any environmental scientist familiar with environmental analyses, ACCESS and EXCEL (motion pp 23 and 24). Dr. Cowan PCA run that includes 419 samples for 56 constituents (Defendants' motion p 24) is not appropriate and the results are meaningless. PCA is used to explain variance or the variability among samples results for various constituents. Constituents with a large percentage of nondetect values have little variance and are therefore not appropriate for PCA.

I declare under penalty of perjury, under the laws of the United States of America, that the foregoing is true and correct.

Executed on the 5th day of June, 2009.

Roger L. Olsen

Roger L. Olsen, Ph.D.

IN THE UNITED STATES DISTRICT COURT FOR THE
NORTHERN DISTRICT OF OKLAHOMA

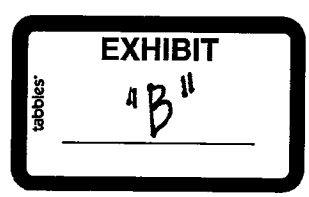
W.A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT, C. MILES TOLBERT in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,	)	09:03:16
Plaintiff,	)	09:03:16
vs.	) 4:95-CV-003290-TCK-SAJ	
TYSON FOODS, INC., et al.,	) (VOLUME I)	09:03:16
Defendants.	)	09:03:16

- -

09:03:16

VOLUME I OF THE VIDEO DEPOSITION OF BRIAN MURPHY, Ph.D., produced as a witness on behalf of the Defendants in the above styled and numbered cause, taken on the 25th day of March, 2009, in the City of Tulsa, County of Tulsa, State of Oklahoma, 09:03:16 before me, Karla E. Barrow, a Certified Shorthand Reporter, duly certified under and by virtue of the laws of the State of Oklahoma.

09:03:16



MS. COLLINS: We are in the process of getting a more recent resume, and I can provide that to you later this morning, as well, just so you can see the actual cases since this time frame.

MR. PAGE: Thank you. 09:11:18

A The three gas plant cases are Fitchburg Gas & Electric in Massachusetts, Orange & Rockland Gas plants, I think there were five of them, in New York state, and Brooklyn Union Gas, which also was multiple gas plants also in New York state, and in 09:11:29 every case, the issue is -- that I've investigated is how did the contamination occur. In particular, was it through intentional acts or through accidental spills and leaks. These are all -- involved disputes between an insurance company or 09:12:07 companies and a utility.

Q And what type of evidence -- let me strike that. What kind of analysis did you perform in order to determine whether the releases, I guess, of the contaminants were intentional or accidental? 09:12:16

A I basically look at three lines of evidence. One is my knowledge of the history of the manufactured gas plant industry, the second is the history of the individual plants based on records that pertain to the plants, as well as newspaper and 09:12:24

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magazine information, and then the third is the pattern of contamination based on most recent remedial investigations.

Q Okay. Did you employ any multivariate statistical analysis in your analysis of those three gas plant cases? 09:13:03

A Not those three, but in another gas plant I have.

Q Okay. So did you -- were you -- have you provided any expert testimony in a court of law in any of those three cases? 09:13:09

A No, they've all been depositions.

Q Okay. Did you issue a written report?

A In all cases I did, yes.

Q Okay. Now, and I think you mentioned then another piece of testimony you gave that did not make it to your December 2007 report or CV, and that was a super phosphate -- 09:13:15

A Yes.

Q -- plant? Could you describe that, please, in the same fashion? 09:13:24

A Again, it's a plant where super phosphate was manufactured for fertilizer, and it's in the Mid-Atlantic. There's lead and arsenic contamination, as well as some PCB contamination or 09:13:32

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as well as in the soils.
Q Did your PCA involve more than one media?
A It did, although not at the same time.
Q Okay. So you did a separate, let's say, liquids media PCA from a solids media PCA? 10:05:20
A Yes.
Q Why did you not combine them together in that case?
A Well, because the fingerprint isn't preserved going from one medium to another. Again, different 10:05:26
PAHs have different transport properties in the environment.
MR. PAGE: Let's take a break.
VIDEOGRAPHER: We are going off the record. The time is now 10:05 a.m. 10:06:04
(Following a short recess at 10:06 a.m., proceedings continued on the record at 10:27 a.m.)
VIDEOGRAPHER: We are back on the record. The time is 10:26 a.m.
Q (By Mr. Page) Dr. Murphy, before the break, 10:27:07
we were discussing some of your past experiences professionally, and my recollection is is that what you testified so far, and if you would confirm this, you employed PCA on two occasions that we've talked about, one at the phosphorus plant and one involving 10:27:18

a gas plant releases in a Maine harbor; is that correct?

A In addition to this case, yes.

Q Okay. So in all of your professional career, if you include this case, you've used PCA in your investigations three times? 10:27:27

A On specific cases, yes.

Q What about -- I want to make sure we're speaking the same language, so to speak. Have you employed PCA in any other professional investigations, may not have been associated with litigation or a case, other than what you've testified to so far today? 10:28:07

A Oh, I've edited a textbook that has a chapter on PCA, and I did edit that chapter and made various corrections, so that's part of my professional work, also. 10:28:14

Q Okay. Any other source investigations where you may not have been involved in litigation, but you employed PCA to determine or help identify the sources of contamination in the environment? 10:28:21

A Not that I can recall at this time.

Q And is it fair for me to understand that in the two cases prior to the present case, when you employed PCA, you did not use the multimedia PCA 10:29:04

MS. COLLINS: Okay. And I object to the extent that this is new information that Dr. Murphy hasn't had a chance to view the underlying analysis of, much less these actual documents.

MR. PAGE: I understand. I'm using it for cross examination of this witness. 03:09:15

Q (By Mr. Page) Dr. Murphy, does the Cargill litter samples fall within the group of poultry litter samples shown on the first page of Exhibit 6 to your deposition? 03:09:24

A The samples that are identified as Cargill fall within the percent of all poultry litter samples identified as all poultry litter.

Q Okay. Do you see where the -- the cattle samples fall, sir, cow manure samples? 03:10:02

A Yes, I do.

Q Are they separate from the poultry litter samples?

A On this figure, they are separate.

Q Let's look at the second page of this. This is a similar document that was corrected using the analysis, the corrected analysis, but it's similar to Figure 3.2 of your deposition -- of your report. 03:10:10

MS. COLLINS: Same objection.

Q (By Mr. Page) Can you identify whether or not 03:11:04

A There they are also occupying a different portion of the PC1, PC2 space.

Q Okay. On the second page, sir, of Exhibit No. 6, would you take that red pen and circle all the poultry litter samples, sir, and label poultry, all poultry, please? Sir, did you happen to -- oh, you've got that one up there, too. Okay. And would you circle the cow sample area of the location, sir, on this same page of this exhibit? 03:13:02

A (Witness complies.) 03:13:20

Q Label it cow manure. Pass me this, please.

A (Witness complies.)

Q Does this analysis on Page 2 of this exhibit indicate that some of the sediment samples are similar to poultry litter? 03:14:17

A Within the context of Dr. Olsen's analytes, some of the sediment samples are in the same part of space as the poultry litter, that is, PC2, PC3 space, not PC1, PC2 space.

Q If you'd turn back to Exhibit 3-1, sir, of your report. Can you identify the cow manure samples on that? Yes, sir. Would you circle those and label them cow manure? 03:15:03

A (Witness complies.)

Q And in your opinion, sir, does this plot 03:15:19

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indicate that the cattle manure are a different type of samples than the poultry litter?

A It indicates that they do occupy a different portion of the space, in Dr. Olsen's uncorrected figure, and also within the context of Dr. Olsen's analytes. 03:15:32

Q Did you investigate any -- did you investigate whether or not the soils in the IRW have phosphorus in them in excess of agronomic needs?

A Repeat the last word. 03:16:18

Q Agronomic needs?

A Oh. I did not.

Q Do you know whether or not the United States Geological Survey has designated the IRW as among the U.S. watersheds having the highest P concentrations in surface waters? 03:16:28

A The highest what concen --

Q Phosphorus.

A P concentrations.

Q Sorry for the abbreviation. 03:17:03

A I'm not aware of that.

Q Okay. If that was the case, sir, would you have any understanding of why the IRW would have such high concentration of phosphorus in its surface waters. 03:17:11

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three separate groups for these three separate source categories?

MS. COLLINS: Object to form.

A Well, they're not really separate in that there's some other kinds of samples mixed in but they -- the figures I do -- I did draw do enclose or are in relative position to each other. 01:52PM

Q And so there's not an overlap between the different groups, is there?

A Not in either figure, no. 01:53PM

Q So is it fair to conclude that although unfortunate, the mathematical calculation did not affect Dr. Olsen's ability to interpret these scores plots?

MS. COLLINS: Object to form. 01:53PM

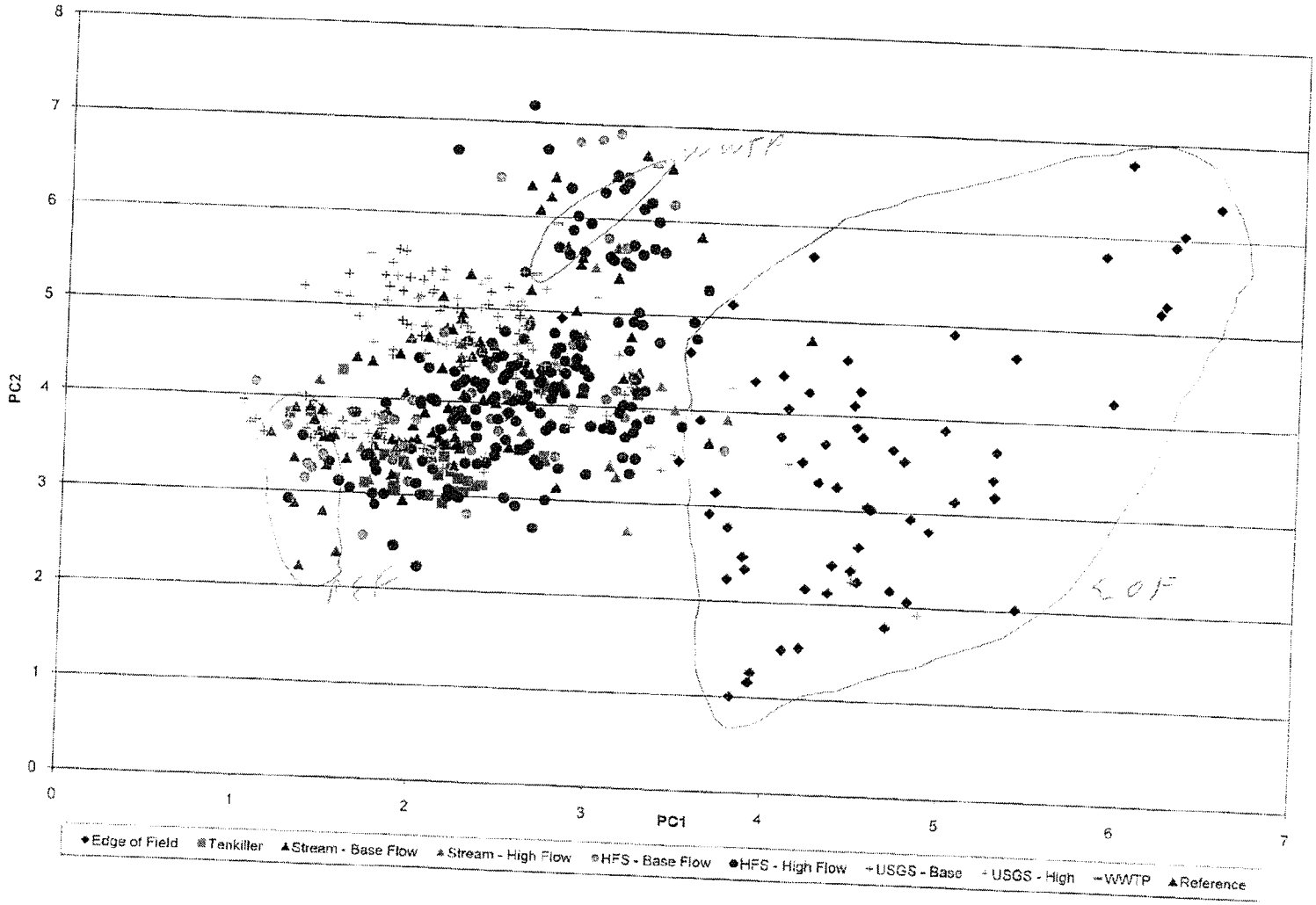
A This is the plot just for surface waters, and I'd need to see what the original and corrected versions looked like for the other runs, the SD 1 and so on.

Q But for the surface waters, would you -- 01:53PM

A For the surface water, the clustering is about the same.

Q So you could do the interpretation either way; correct?

MS. COLLINS: Object to form. 01:53PM



MURPHY
DEPOSITION EX# 32

Corrected Figure 6.11-18d
PC1 vs. PC2 Scores: Surface Waters (SW3)

IN THE UNITED STATES DISTRICT COURT FOR THE

NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,

Plaintiff,

vs. 4:05-CV-00329-TCK-SAJ

TYSON FOODS, INC., et al,

Defendants.

VOLUME I OF THE VIDEOTAPED

DEPOSITION OF GLENN JOHNSON, PhD, produced as a witness on behalf of the Plaintiff in the above styled and numbered cause, taken on the 24th day of February, 2009, in the City of Tulsa, County of Tulsa, State of Oklahoma, before me, Lisa A. Steinmeyer, a Certified Shorthand Reporter, duly certified under and by virtue of the laws of the State of Oklahoma.

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sediments of Little Mississinewa in flood plain in Union City, Indiana. The case settled. I was deposed in August of 2007.

Q And what were the subjects of your expert report in that case? I guess it was located in Little Mississinewa? 09:10AM

A The city is Union City, Indiana.

Q Okay.

A The river is the Little Mississinewa. It's one of those words I've read a million times but pronounce very infrequently, so I'm not even sure I've got the pronunciation correct. 09:10AM

Q Can you refer to it as the Union City case?

A Union City, yes, that would be fine.

Q Okay. In that case, what were the subjects of your report? 09:10AM

A Sources -- sources and alteration of polychlorinated biphenyls in sediments.

Q And did you employ PCA analysis in that report? 09:11AM

A I employed a technique called polytopic vector analysis, which uses PCA as an initial step.

Q Okay, and were you -- was your purpose to identify sources of the PCBs in the sediments in that case? 09:11AM

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sir?

A Again, this was PCBs. Going from memory here, but I believe Teledyne Ryan had used PCBs in -- as hydraulic fluids, and that was consistent with a certain Aroclor that's often used in hydraulic called Aroclor 1248, and I reviewed the sediment data from catch basins and storm sewers underneath their facility, which was also predominantly 1248 and other -- and some of the other Aroclors, and I reviewed the PCB data from up the storm drain that had been collected. I'm sorry. Did I answer your question? 09:15AM 09:16AM

Q I think we're getting there.

A Okay.

Q Let me ask this question as a follow-up to your answer: Did you then compare what you understood that the entities that could have been the potential sources, their PCBs that you used, with the type of PCBs that were found in this cove to see if there was similarity; was that part of your source analysis? 09:16AM 09:16AM

A Yes, it was part.

Q Okay, and if I understood it correctly, you also looked at enter -- I guess transport locations along the way between where the PCBs could have been 09:17AM

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of raw data by bar graphs.

Q Have you heard of something called the weight of evidence approach?

A Yes.

Q And what do you understand that phrase to mean? 09:27AM

A My understanding is that you take -- you take into account multiple lines of evidence into -- into coming to a conclusion.

Q Okay. Did you employ a multi -- excuse me, a weight of evidence approach when you worked on any of the cases you testified to? 09:27AM

A I don't know if I used that term, but I believe that, yeah, I would take into account the information that I had at hand. 09:28AM

Q So there would be multiple lines of evidence to support a conclusion that a source was or wasn't responsible for contamination?

A Yes, I believe so.

Q Is it your experience that that's a common approach in identifying sources of contamination in the environmental field? 09:28AM

A I think so.

Q Okay. Now, I think I was asking, and I don't recall if I gave you an opportunity to answer or 09:28AM

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Q How would you characterize the next entry? Can you give us a shorthand term? It just says a U.S. river estuary.

A There's sources of -- I'm not exactly sure what you're asking, but we were looking at sources of dioxin in sediments of a river. 09:30AM

Q And did you say you did or did not employ PCA in that case?

A I believe we did.

Q You did, okay. Did you prepare a report? 09:30AM

A No.

Q Did you prepare any PCA findings?

MR. GEORGE: Object to form.

A I probably discussed them with my client. I'm hesitant to answer too many questions about consulting expert projects where I was under confidentiality. So far I don't think we've crossed into questions that I'm unable to speak of, but I feel we're getting close. 09:30AM

Q What about the next item on the list? Looks like the Pacific Northwest river? 09:31AM

A Oh, this was on -- yeah. This was dioxins again. I'm sorry, what was the question with regard to this entry?

Q You were looking for the source of dioxin 09:31AM

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Q Okay, and I think in that case we were just referring to mentioning New York, you said some -- in some instances you wouldn't be able to identify the source and some instances you were not; correct?
A That's correct. 09:39AM
Q Okay. The next case, again you mention PCB fingerprinting. Did you employ PCA, by the way, in the last case, that one in New York?
A I don't recall. It was a small number of samples. So probably would not have been necessary, 09:39AM
but I don't recall if I would have ran an analysis like that or not.
Q Okay. In the case that you mentioned below that references a 1999 matter you worked on. Did you employ PCA in that particular case? 09:39AM
A Well, that's almost ten years ago. Yes, I did, not PCA, but a receptor modeling technique that uses PCA as a mathematical -- part of a mathematical bases.
Q Has a multivariate analysis? 09:39AM
A Exactly, a multivariate analysis.
Q Okay, and in that case were you able to identify sources of contamination?
A I don't recall. I do know that we had dechlorination, so we had alteration. I don't 09:40AM

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recall if the alteration was to the extent that made it difficult to identify sources or not.

Q Okay, and the next case, I think it's referred to PAHs in Tacoma, Washington?

A Yes. 09:40AM

Q Did you -- were you doing source identification in that case also?

A Yes, I was.

Q And did you employ PCA or some type of a multivariate analysis? 09:40AM

A Yes, I did.

Q And were you able to identify a source in that case?

A Yes, but there was -- there was alteration of the PAH patterns, so we had to take into account 09:40AM both.

Q You were able to identify sources even with alteration of the patterns of the PAHs?

A I guess the best way to characterize, we were able to identify sources with some statement about 09:41AM certain patterns that -- certain patterns in certain samples that we were not completely confident in because of the degree of alteration.

Q Are you talking about the degradation of the product, the PAH product; is that what you mean by 09:41AM

kind of -- it was a standard SW-846 method, so an EPA standard method. We had issues with detection limits. There are just too many questions about data quality. This was a very short project. Once I realized that there wasn't a whole lot I could do with this dataset, I advised the client of such, and it was over pretty quickly. 09:43AM

Q Okay. What about the next item? I think it was Greenville, South Carolina. What were the contaminants of concern in that case? 09:43AM

A Contaminant of concern was chromium.

Q Okay, and did you employ a PCA analysis in that case?

A Multivariate analysis.

Q Okay, and were you able to identify the source of the chromium contamination in the groundwater in that case? 09:43AM

A My recollection is that we ended up with like eight to ten, again, I use the term fingerprint, although we're not talking about ridges on thumbs. We identified ten fingerprints. Two of the ten were related -- I believe had -- were related to chromium. 09:43AM

Q Okay, and does that fingerprint, as we're using in this context, include a PCA analysis? 09:44AM

A It was a multivariate analysis that used PCA as an intermediate step.

Q Okay. So you were able to identify the sources of the contamination in the groundwater in that case? 09:44AM

A We found two patterns that were -- their locations were consistent with where -- again, I'm going from memory ten years ago, but were consistent with the locations of known chromium releases, so, yes. 09:44AM

Q Okay. Then the next one, looks like it's -- we're getting back here -- '92 to '94 time period.

A Yeah.

Q What were the contaminants concerned in that case? 09:44AM

A Dioxins.

Q Okay, and you say chemical fingerprints. Did that involve use of a multivariate analysis for those chemical fingerprint analyses?

A Yes, it did. 09:45AM

Q And were you able to identify the source of the dioxin contamination in that case?

A Again, similar to the other dioxin on the earlier page, we could identify what I'll call source categories, but when it came to the point of 09:45AM

study that we were trying to identify the original source rocks that contributed to the patterns we saw in oil, but there was -- in many samples there was a high degree of microbial alteration that confounded our ability to do that. 09:54AM

Q Okay. In some cases you were able to do the source identification and in some case you were not?

A That's my recollection, yeah.

Q Okay. I think the next one is a textbook and I am familiar with that. So let's go to the next page. 09:54AM

A The next one is a PCB study of -- definitely related to sources in the San Francisco Bay.

Q You used a multivariate analysis in this case?

A Yes, and this -- again, this is another example where in some samples we did confidently relate it back to the source pattern and in other samples it looked like there was degrees of alteration. 09:54AM

Q Okay. 09:54AM

A The next one, the Chiarenzelli article, yes, we were looking at air samples and PCB congener patterns and trying to relate that back to sources.

Q Did you identify sources in that case?

A In some cases -- it's been a while. I'd have 09:55AM

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A Not that I recall. I mostly focused on the PCA results to the extent that it's discussed in my expert report.

Q Did you do any evaluation of the chemical constituents of cattle waste? 01:31PM

A Again, that was part of the same two principal component runs that included the poultry litter.

Q But you didn't look at the analytical results on the cattle waste itself?

MR. GEORGE: Object to form. 01:31PM

A I believe that I probably looked at the spreadsheets that contained that data. I did not spend much time reanalyzing that data as I did with the principal components analyses.

Q Did you find that there's a different chemical composition between poultry and cattle waste? 01:32PM

MR. GEORGE: Object to form.

A To the extent it's reflected on that PCA graph, yes. They plot in different locations on the PCA graph, which indicates that at least for the chemicals that are accurately back calculated in that PCA, they have different chemical compositions. 01:32PM

Q Did you do any evaluation of the chemical constituents in human waste?

A No. I don't know that I've seen data that -- 01:32PM

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wastewater treatment plant sample; is that the one that's left out?

Q There's three on the report here. Lincoln was a stream one also, was it not, Dr. Johnson?

A Yes, but -- 03:22PM

Q These are the pure wastewater treatment plant effluents.

MR. GEORGE: Object to form.

Q Do you see three separate groups of patterns on this report as you circled? 03:23PM

A I've drawn three circles here.

Q Do they overlap?

A No.

Q Okay. So is it fair to say there's three separate groupings on this Exhibit 7? 03:23PM

MR. GEORGE: Object to form.

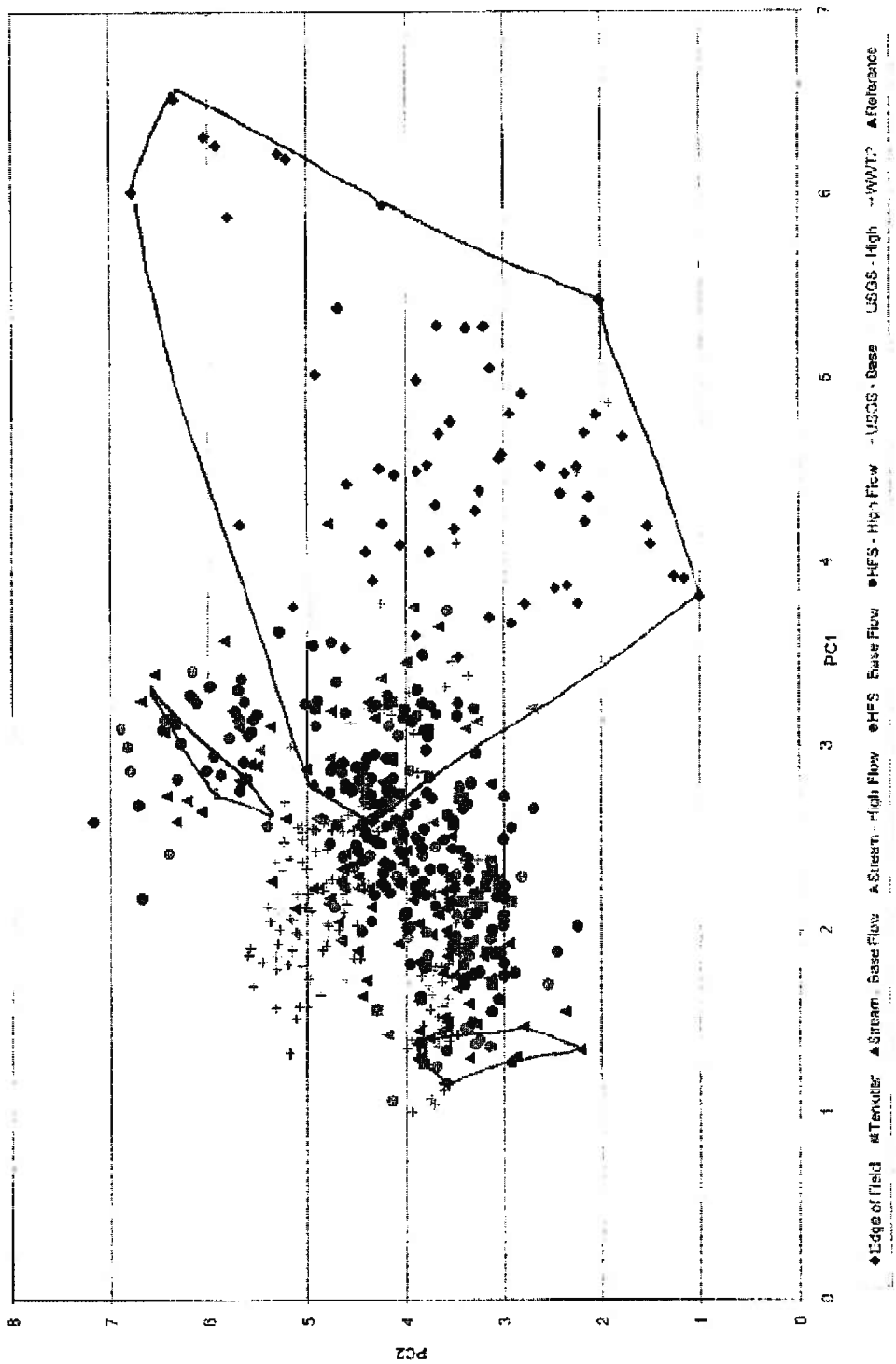
A Within the three context of the three groups you asked me to circle, there's no overlap between those three. There's plenty of overlap between -- with the other samples. 03:23PM

Q Well, the samples that are in the middle, would they not be characterized as mixtures between these three --

MR. GEORGE: Object to form.

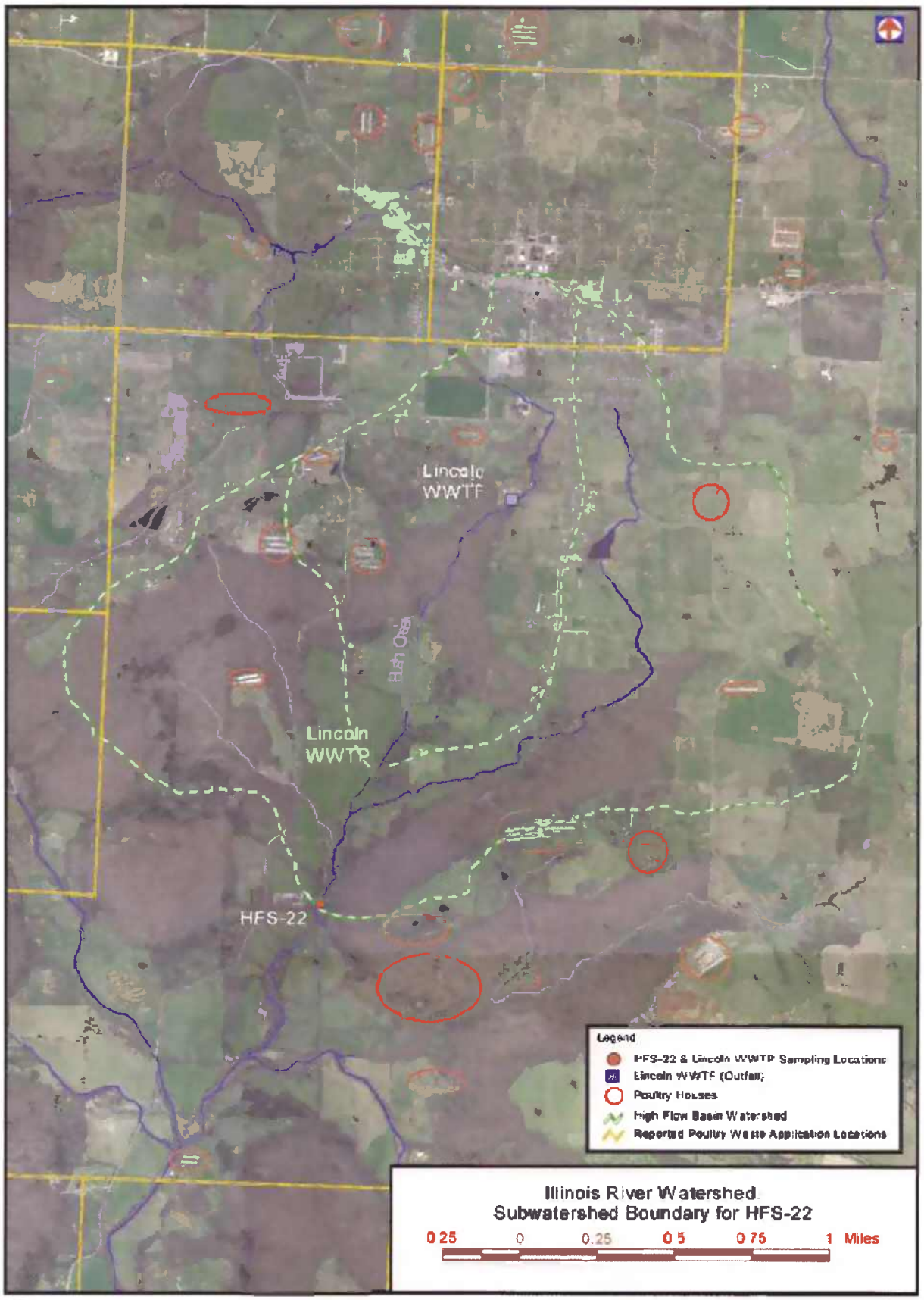
Q -- groups that you've circled? 03:23PM

b50b095f-4e85-40ba-9888-7914278edac4



Corrected Figure 6.11-18d
PC1 vs. PC2 Scores: Surface Waters (SW3)

JOHNSON
DEPOSITION EX# 1



EXHIBIT

Figure J3-13
HFS-22

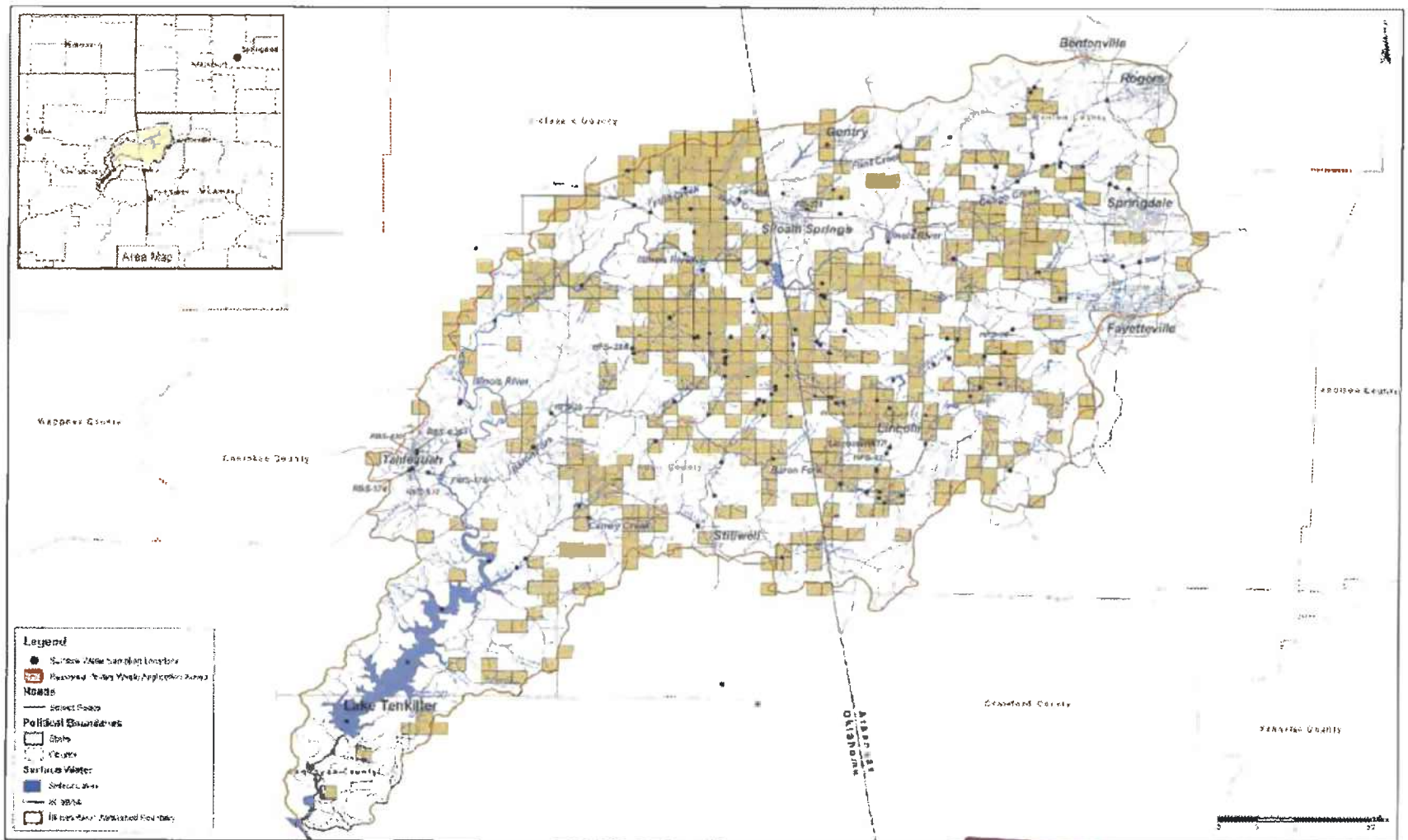
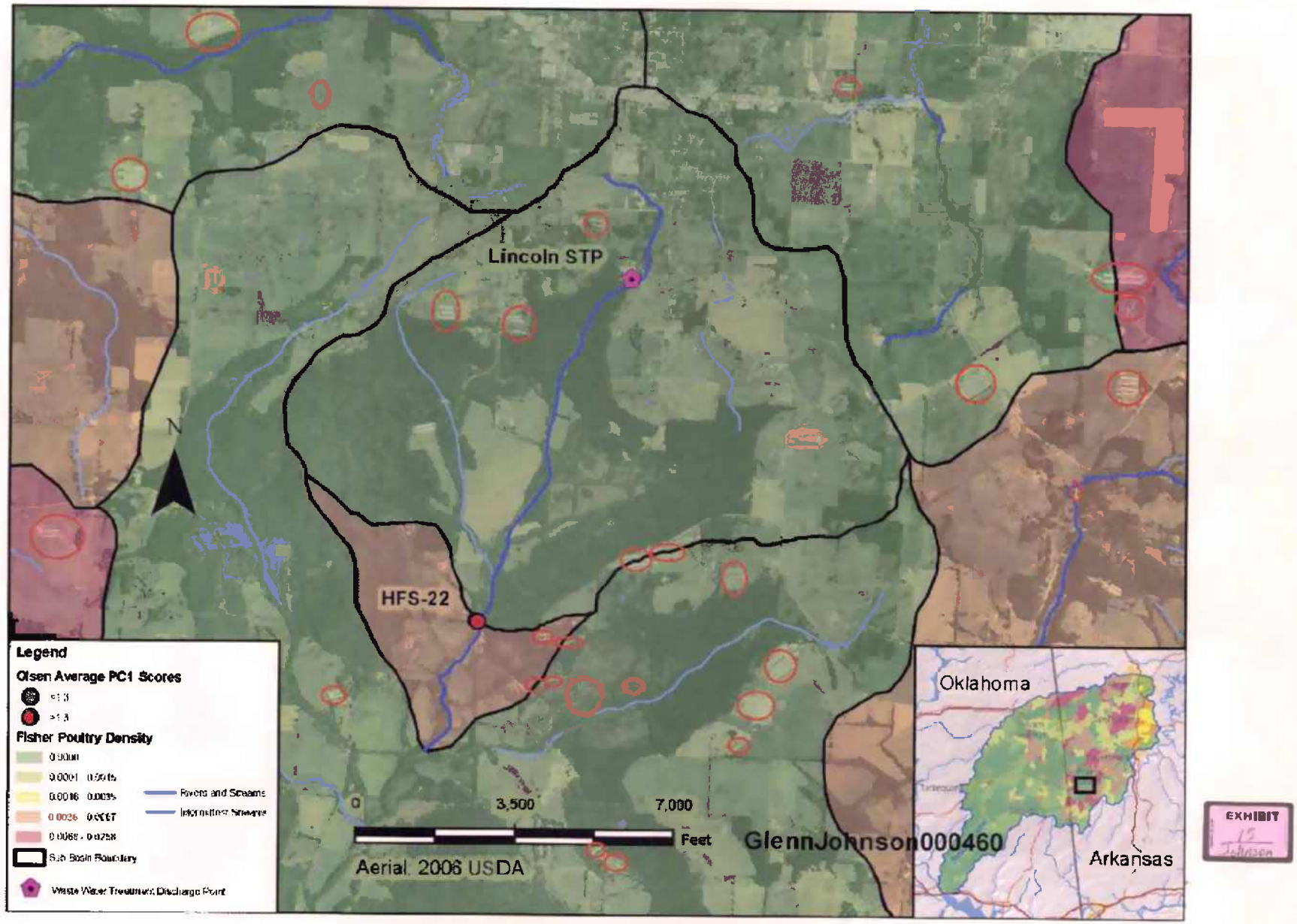
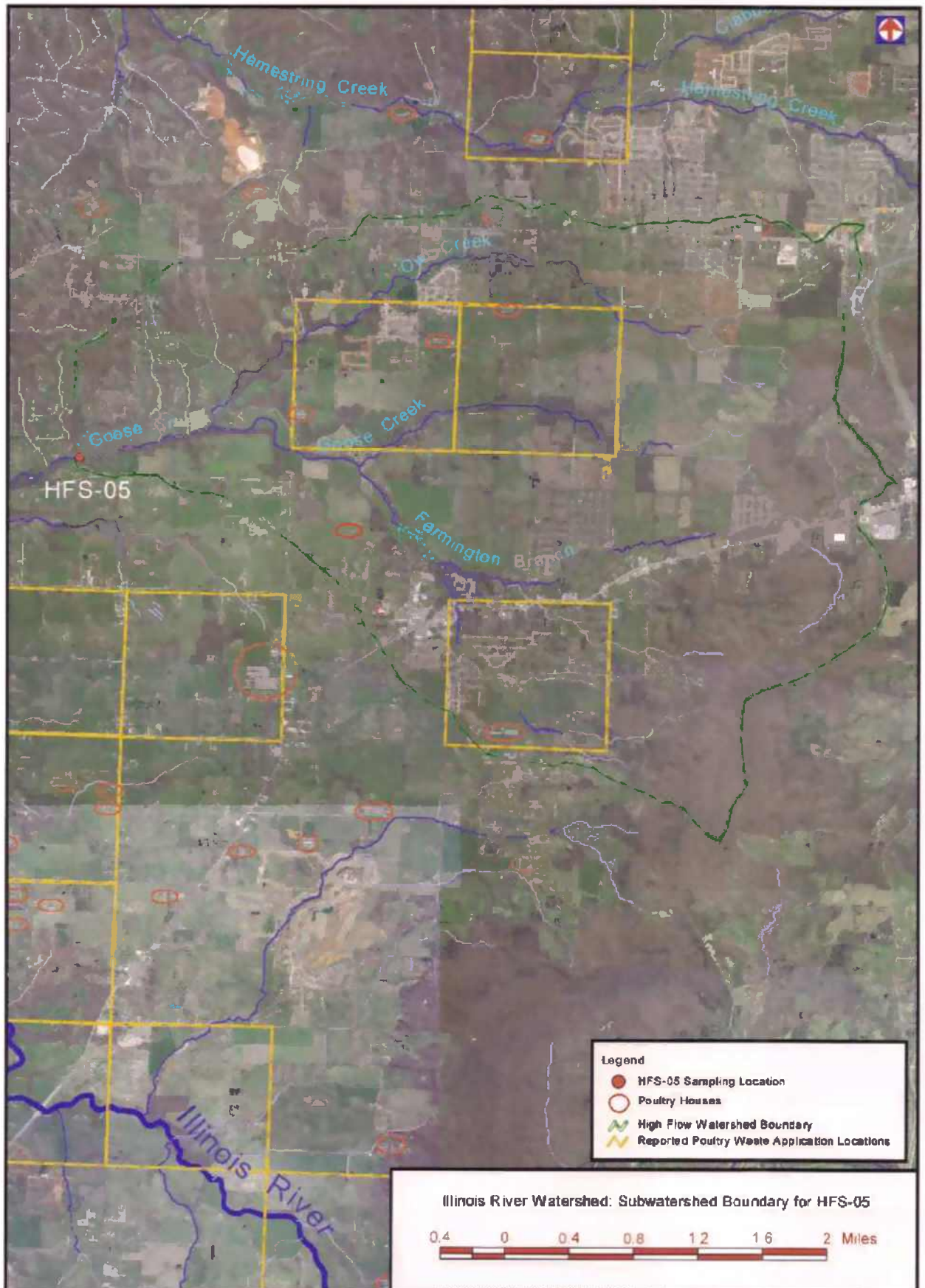


EXHIBIT
4
Johnson

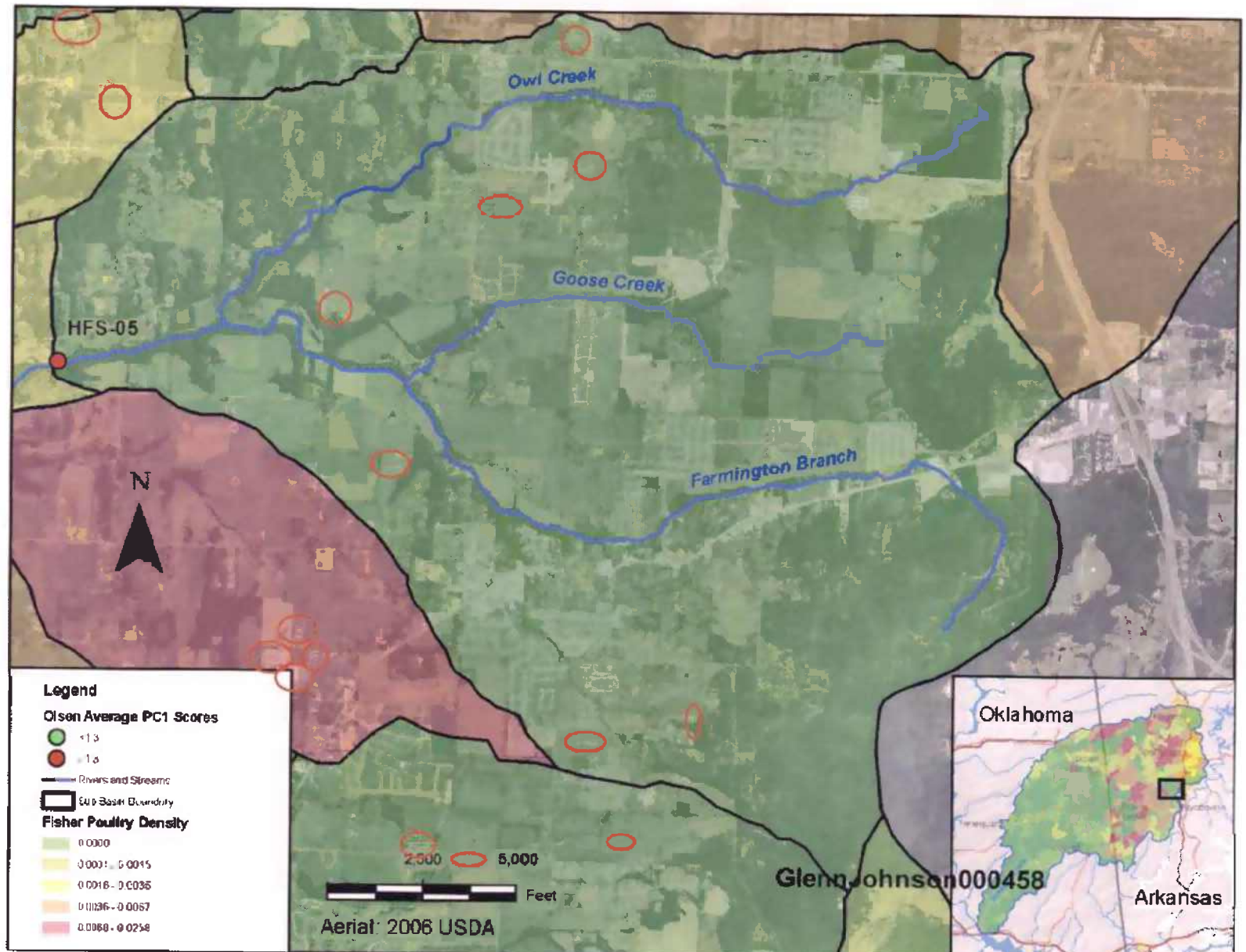
Figure J2-5/J3-15a
Surface Water Sampling Locations and Reported Poultry Waste Application Areas





EXHIBIT

Figure J3-12



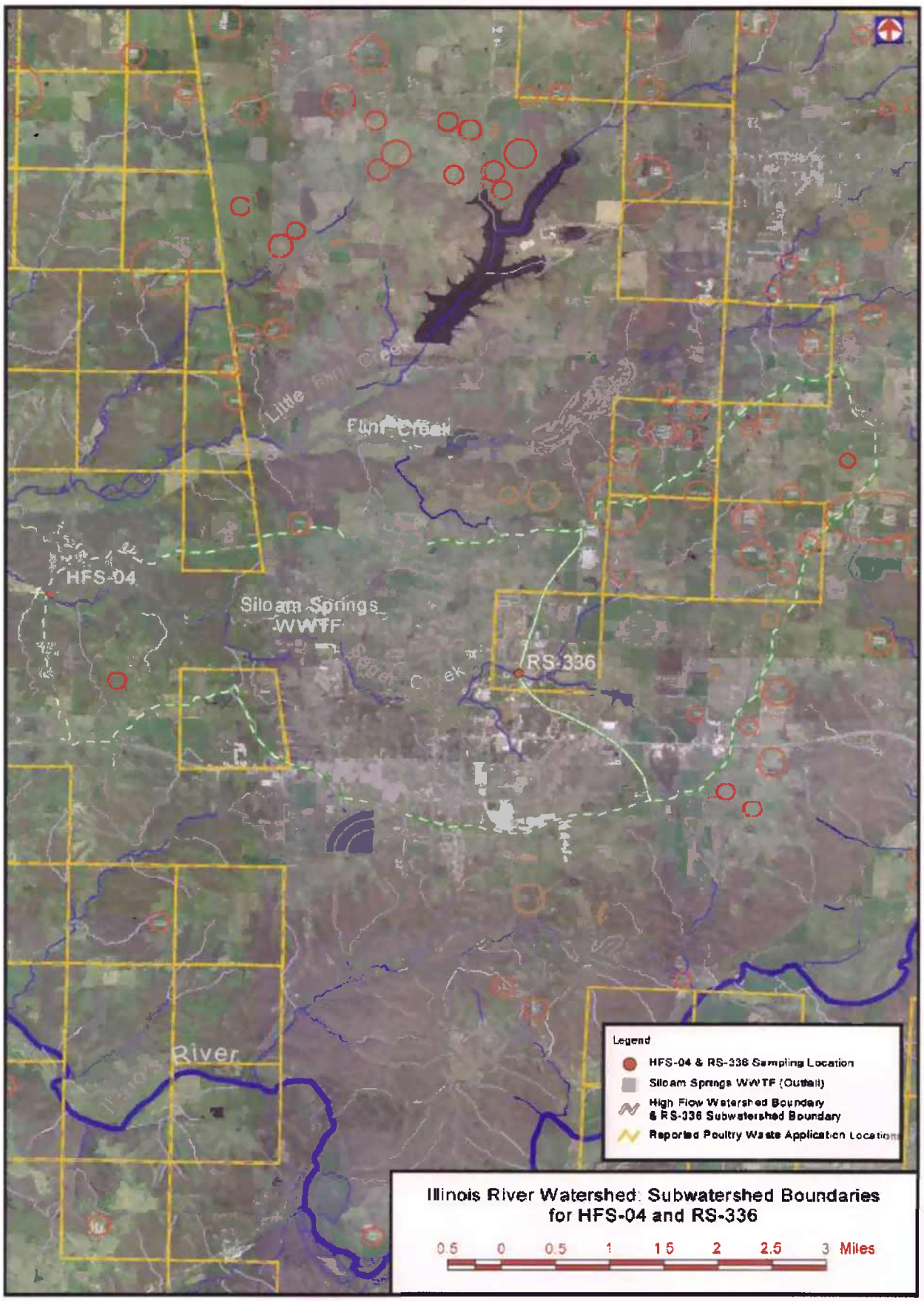


Figure J3-14

EXHIBIT 18 Tehasa

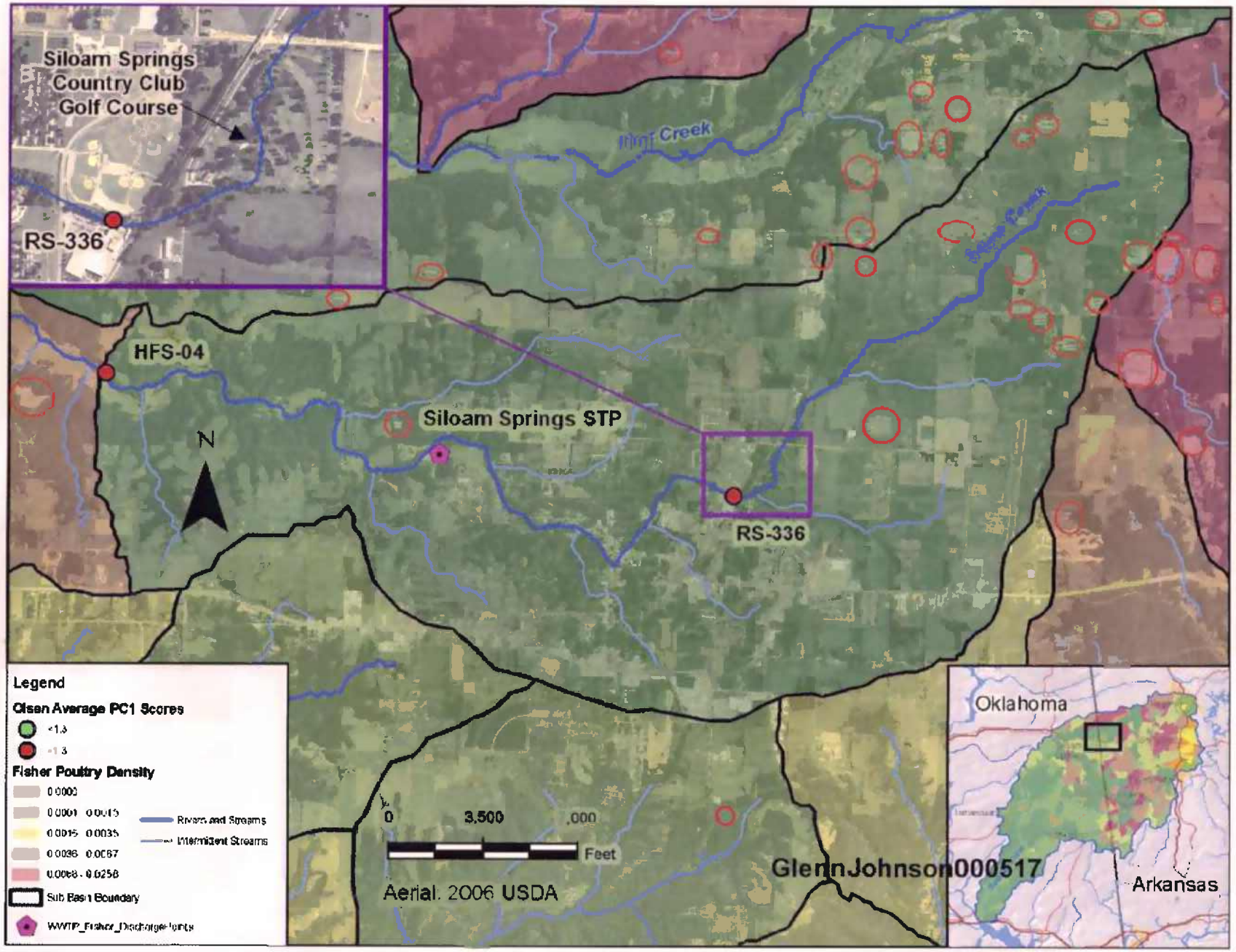


Figure J4-3

EXHIBIT

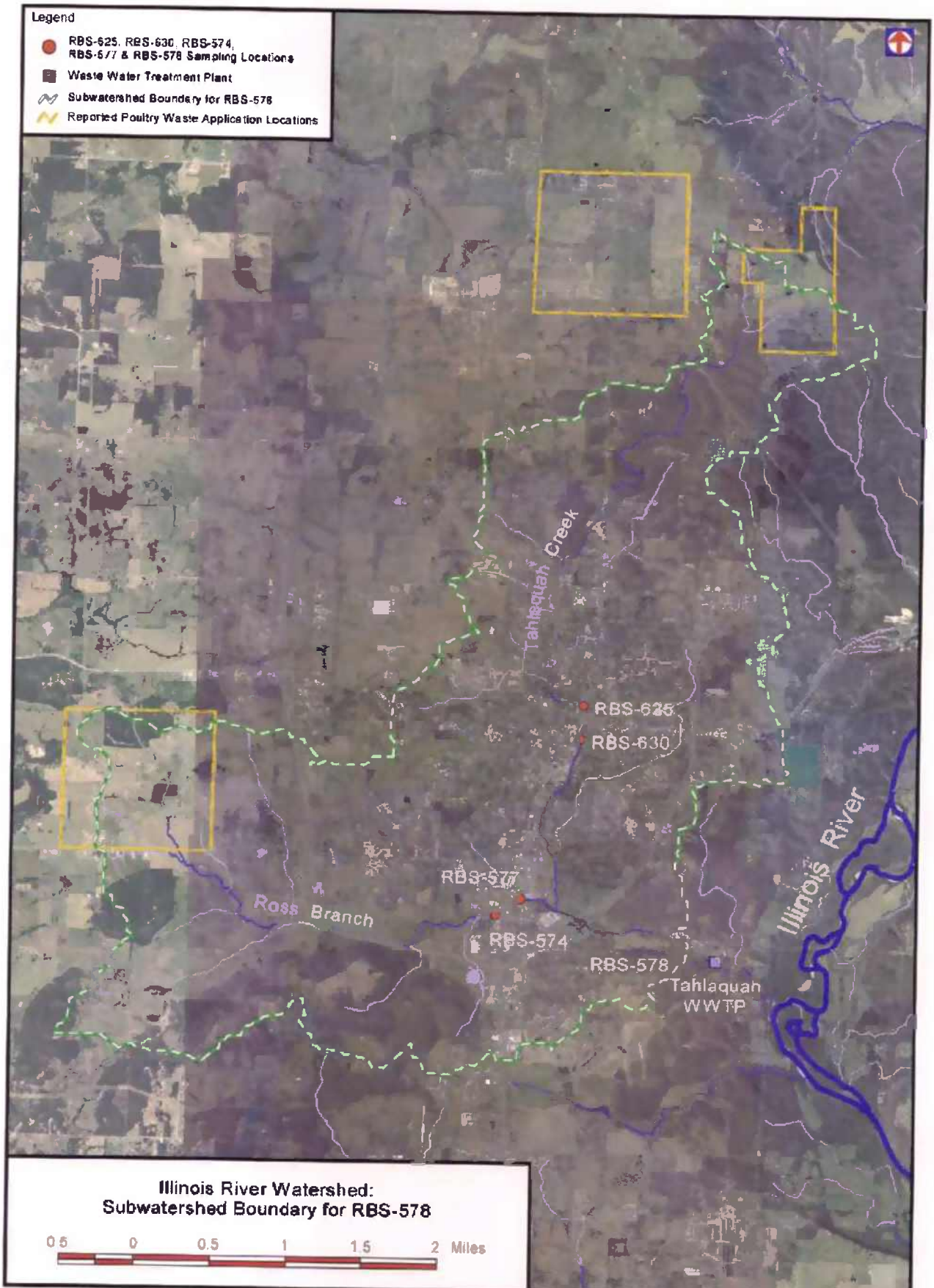
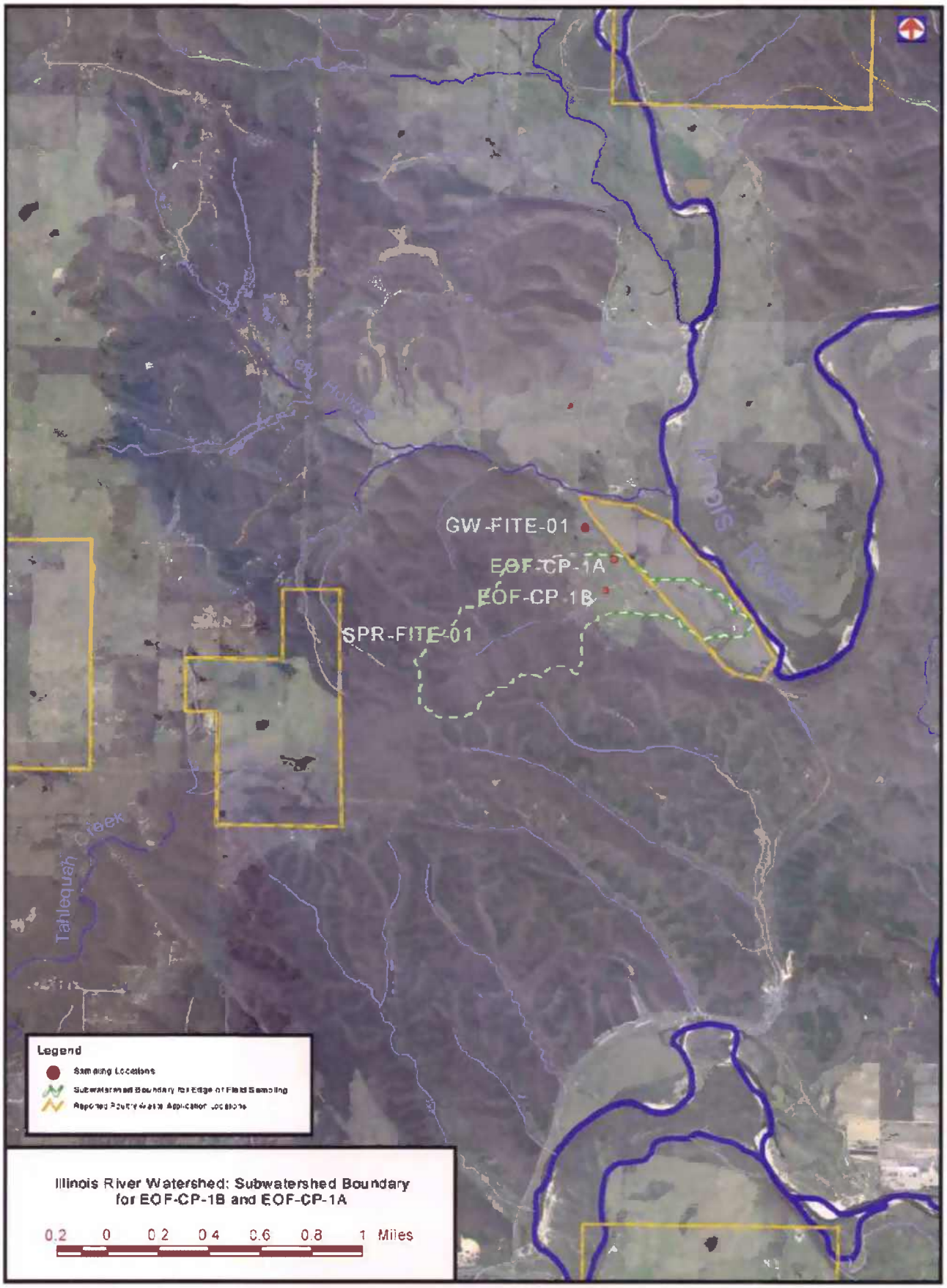


Figure J3-1

EXHIBIT



EXHIBIT

Figure J3-9